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(54) Antenna

(57) A strip-line-type antenna (1) is formed of dielectric layers (11a, 11b, 11c) made of a ceramic sheet, a grounding electrode layer (12) which is disposed on the upper layer of the dielectric layer (11a) and which has nearly the same area of the dielectric layer (11a), a first radiation electrode layer (13) in the shape of nearly a square which is disposed on the upper layer of the dielectric layer (11b), a second radiation electrode layer (14) which is disposed on the upper layer of the dielectric layer (11c) and which is disposed in the shape of nearly the letter L at a position corresponding to the portion where the first radiation electrode layer (13) is not disposed, a through hole (15) for feeding formed from the rear surface of the dielectric layer (11a) to the first radiation electrode layer (13) in order to feed to the first radiation electrode layer, a plurality of through holes (16) for connecting the second radiation electrode layer to the grounding electrode layer, and capacitive coupling sections (17a, 17b) which are protrusively formed in each of the first radiation electrode layer (13) and the second radiation electrode layer (14) in order to capacitively couple the first radiation electrode layer (13) to the second radiation electrode layer (14).

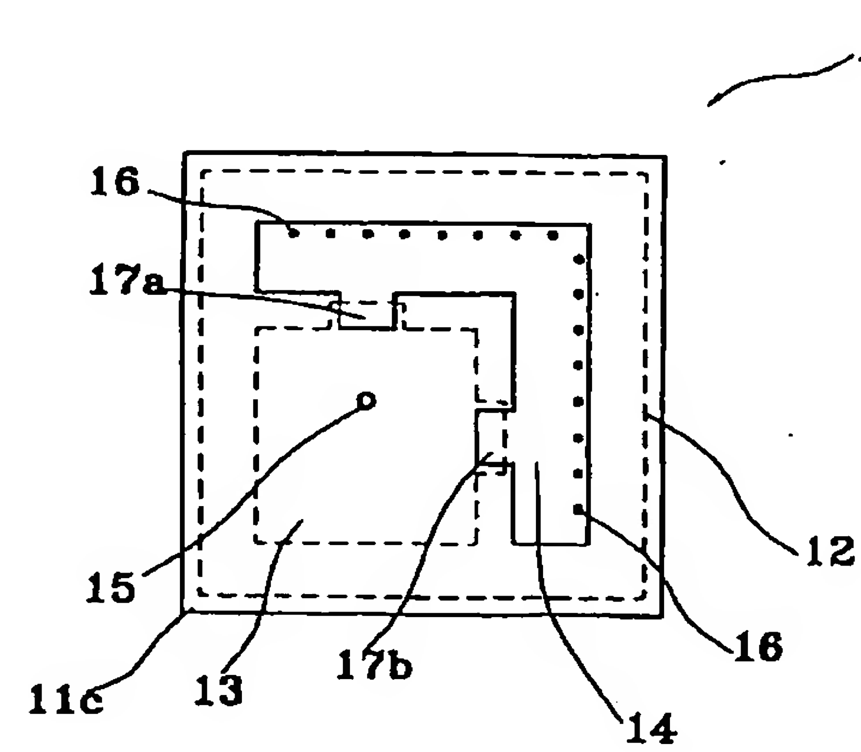

FIG. 1

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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to an antenna and, more particularly, to an antenna which supports a plurality of frequency bands and which is capable of selecting a polarized wave.

2. Description of the Related Art

A conventional antenna will be described below with reference to Figs. 5 to 8.

An antenna 100 shown in Figs. 5 and 6 is formed of a substrate 101 made of a dielectric material, a radiation electrode 102 formed on one main surface of the substrate 101, and a grounding electrode 103 formed on the other main surface of the substrate 101, with a through hole 104 for feeding being provided at a place corresponding to the radiation electrode 102 of the substrate 101. A connector 105 for feeding to the radiation electrode 102 is inserted into the through hole 104 in such a manner as to go through the substrate 101 from the other main surface of the substrate 101. The connector 105 is made to conduct with the radiation electrode 102 by solder 106a and is fixed to the substrate 101 by the solder 106a and solder 106b.

This antenna 100 receives circularly polarized waves, with a degeneration separation section 102a being provided in the radiation electrode 102, as shown in Fig. 5.

Next, an antenna 110 shown in Figs. 7 and 8 is formed of a substrate 111 made of a dielectric material, a radiation electrode 112 formed on one main surface of the substrate 111, and a grounding electrode 113 formed on the other main surface of the substrate 111, with a through hole 114 for feeding being provided at a place corresponding to the radiation electrode 111 of the substrate 111. A connector 115 for feeding to the radiation electrode 112 is inserted into the through hole 114 in such a manner as to go through the substrate 111 from the other main surface of the substrate 111. The connector 115 is made to conduct with the radiation electrode 112 by solder 116a and is fixed to the substrate 111 by the solder 116a and solder 116b.

This antenna 110 receives linearly polarized waves, and unlike the radiation electrode 102 of the antenna 100, a degeneration separation section is not provided in the radiation electrode 112, as shown in Fig. 7.

However, in the above-described conventional antennas, frequency bands to be received by each antenna are separated, and polarized waves to be received are different. In the case where such separated frequency bands are to be received at the same time, the following methods are possible:

(1) two antennas are disposed side by side,

(2) two radiation electrode patterns are formed on one substrate, and antennas for feeding to the respective radiation electrodes are used.

However, in each case of (1) and (2), two radiation electrodes which support different frequency bands must be disposed with a sufficient spacing so as not to interfere with each other, and feeding means, such as a connector, must be provided in each radiation electrode. This is an obstacle to forming an antenna into a small size.

To solve the above problems, it is an object of the present invention to provide an antenna which supports a plurality of frequency bands and which is capable of selecting a polarized wave and is formed in a small size.

SUMMARY OF THE INVENTION

To achieve the above-described object, the present invention provides an antenna of the lamination-type in which a dielectric layer, a first radiation electrode layer, a second radiation electrode layer, and a grounding electrode layer are laminated, the dielectric layer being formed between each pair of the first radiation electrode layer, the second radiation electrode layer, and the grounding electrode layer, the antenna comprising: a capacitance coupling section, provided on the first radiation electrode layer and the second radiation electrode layer, for capacitively coupling between the first radiation electrode layer and the second radiation electrode layer; a feeding section for feeding to the first radiation electrode layer; and a through hole through which the second radiation electrode layer and the grounding electrode layer are brought into conduction.

With this construction, the first radiation electrode layer operates as an antenna which supports one frequency band, the first radiation electrode layer and the second radiation electrode layer are capacitively coupled to form another strip line, and thus this operates as an antenna which supports another frequency band. Therefore, an antenna which supports a plurality of frequency bands by one block can be obtained, and only one feeding section is required to feed to radiation electrodes, and a small size can be achieved.

Further, a polarized wave can be selected by adjusting the capacitance value in the capacitive coupling section and on the basis of the position at which the capacitive coupling section is disposed.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a plan view illustrating the construction of a microstrip antenna according to a first embodiment of the present invention.

Fig. 2 is an exploded perspective view illustrating the construction of the microstrip antenna according to the first embodiment of the present invention.

Fig. 3 is a plan view illustrating the construction of a microstrip antenna according to a second embodiment of the present invention.

Fig. 4 is a plan view illustrating the construction in which a degeneration separation section is provided in a first radiation electrode portion in the microstrip antenna of the present invention.

Fig. 5 is a plan view illustrating the construction of a conventional microstrip antenna.

Fig. 6 is a sectional view taken along the line B-B in Fig. 5.

Fig. 7 is a plan view illustrating the construction of the conventional microstrip antenna.

Fig. 8 is a sectional view taken along the line C-C in Fig. 7.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The preferred embodiments of the present invention will be described below with reference to the accompanying drawings.

In Figs. 1 and 2, reference numeral 1 denotes a strip-line-type antenna, which is formed of dielectric layers 11a, 11b and 11c made of a ceramic sheet, a grounding electrode layer 12 which is disposed on the upper layer of the dielectric layer 11a and which has nearly the same area of the dielectric layer 11a, a first radiation electrode layer 13 in the shape of nearly a square which is disposed on the upper layer of the dielectric layer 11b, a second radiation electrode layer 14 which is disposed on the upper layer of the dielectric layer 11c and which is disposed in the shape of nearly the letter L at a position corresponding to the portion where the first radiation electrode layer 13 is not disposed, a through hole 15 for feeding formed from the rear surface of the dielectric layer 11a to the first radiation electrode layer 13 in order to feed to the first radiation electrode layer, a plurality of through holes 16 for connecting the second radiation electrode layer to the grounding electrode layer, and capacitive coupling sections 17a and 17b which are protrusively formed in each of the first radiation electrode layer 13 and the second radiation electrode layer 14 in order to capacitively couple the first radiation electrode layer 13 to the second radiation electrode layer 14.

Though not particularly shown in the figure, a connector serving as a coaxial line for feeding to the first radiation electrode layer 13 is inserted into the through hole 15 for feeding, and the first radiation electrode layer 13 and the connector are brought into conduction and fixed by solder.

The strip-line-type antenna 1 constructed as described above is capacitively coupled between the first radiation electrode layer 13 and the second radiation electrode layer 14 by the capacitive coupling sections 17a and 17b. For this reason, the first radiation electrode layer 13 portion functions as an antenna which supports one frequency band (high frequencies), and further, the whole portion containing the first radiation electrode layer 13 and the second radiation electrode layer 14 functions as an antenna which supports another frequency band (low frequencies).

Next, an antenna 20 according to a second embodiment of the present invention will be described with reference to Fig. 3. Components in the antenna 20 which are the same as those of the antenna 1 shown in Fig. 1 are given the same reference numerals, and therefore, a description thereof has been omitted.

The difference of this antenna 20 from the antenna 1 is that second radiation electrode layers 22, 23, 24 and 25 in a nearly rectangular shape are disposed in portions corresponding to the positions which surround all the four sides of the first radiation electrode layer 13 formed as nearly a square, and capacitive coupling sections 17a, 17b, 17c and 17d for capacitively coupling the first radiation electrode layer 13 to the second radiation electrode layers 22, 23, 24 and 25 are disposed.

This antenna 20 functions as a microstrip antenna such that the first radiation electrode layer 13 supports one frequency band, the first radiation electrode layer 13 and the second radiation electrode layers 22 and 23 support another one frequency band, and the first radiation electrode layer 13 and the second radiation electrode layers 24 and 25 support still another one frequency band.

Though not particularly shown in the figure, similar to the antenna 1 shown in the first embodiment, in this antenna 20, the second radiation electrode layers 22 and 23 may be coupled nearly in the shape of the letter L, and the second radiation electrode layers 24 and 25 may be coupled nearly in the shape of the letter L.

Further, though this is not also particularly shown in the figure, in the antenna 1, similar to the antenna 20, the second radiation electrode layer 14 may be formed divided nearly in the shape of a rectangle.

Although in the antenna shown in the above-described first and second embodiments the first radiation electrode layer and the second radiation electrode layer are capacitively coupled by a capacitive coupling section, it is possible to easily adjust the frequency band to be received on the low frequencies and select a polarized wave to be received on the low frequencies by deviating the position at which the capacitive coupling section is formed or by trimming the capacitive coupling section.

Further, since this capacitive coupling section is of a lamination-type and does not require special manufacturing steps, formation thereof is easy, and a low height of the antenna can be achieved because the thickness thereof is small.

Further, the first radiation electrode layer 13 described in each embodiment, in a shape having the degeneration separation section 13a as shown in Fig. 4, is also capable of selecting a polarized wave on the high frequencies to be received by the first radiation elec-

trode layer 13. Since components in Fig. 4 which are other than the degeneration separation section 13a are the same as those of the microstrip antenna 1 shown in the above-described first embodiment, they are given the same reference numerals, and therefore, a description thereof has been omitted.

As described above, in the antenna of the present invention, it is possible to set a polarized wave in the first radiation electrode layer which supports one frequency band (high frequencies), and in the whole portion containing the first radiation electrode layer and the second radiation electrode layer, which supports another frequency band (low frequencies), it becomes also possible to select a polarized wave.

Further, although in the above-described first and second embodiments the first radiation electrode is shaped nearly as a square, it may be shaped nearly as a circle.

Further, although in the above-described embodiment the second radiation electrode layer and the grounding electrode layer are connected to each other by a plurality of through holes, if the second radiation electrode layer is grounded in terms of a high frequency, the number of through holes may be appropriately selected and determined.

Although in the above-described embodiment a dielectric layer is formed by using a ceramic sheet, the ceramic sheet of the bottommost layer may be an alumina substrate, an aluminum nitride substrate or the like.

Furthermore, the antenna of the present invention is obtained by laminating a plurality of ceramic sheets and a plurality of electrode layers and then calcining them. Though not particularly shown in the figure, after a plurality of electrode patterns are formed on one ceramic sheet and calcined, the sheet is divided and cut, making it possible to manufacture a large number of antennas. Thus, the cost can be reduced.

As described above, in the microstrip-type antenna of the present invention, the first radiation electrode layer functions as an antenna which supports one frequency band, and the first radiation electrode layer and the second radiation electrode layer are capacitively coupled to form another microstrip line and function as an antenna which supports another frequency band. Thus, an antenna which supports a plurality of frequency bands can be obtained on one substrate. Further, since feeding to radiation electrodes requires only one feeding section, a small size can be achieved.

Further, it becomes possible to select a polarized wave by the adjustment of the capacitance value in a capacitive coupling section and on the basis of the position at which the capacitive coupling section is disposed.

Claims

1. An antenna (1;20) of the lamination-type in which a dielectric layer (11a, 11b, 11c), a first radiation electrode layer (13), a second radiation electrode layer (14; 22, 23, 24, 25) and a grounding electrode layer (12) are laminated, said dielectric layer being formed between each pair of said first radiation electrode layer, said second radiation electrode layer, and said grounding electrode layer, said antenna comprising:

   a capacitance coupling section (17a, 17b; 17a, 17b, 17c, 17d), provided on said first radiation electrode layer (13) and said second radiation electrode layer (14; 22, 23, 24, 25), for capacitively coupling between said first radiation electrode layer and said second radiation electrode layer;
   a feeding section (15) for feeding to said first radiation electrode layer; and
   a through hole (16) through which said second radiation electrode layer (14; 22, 23, 24, 25) and said grounding electrode layer (12) are brought into conduction.

2. The antenna (1) according to claim 1, wherein the first radiation electrode layer (13) is in the shape of nearly a square, and the second radiation electrode layer (14) is disposed in the shape of nearly the letter L at a position corresponding to the portion where the first radiation electrode layer (13) is not disposed.

3. The antenna (1) according to claim 1, wherein the first radiation electrode layer (13) is in the shape of nearly a square, and the second radiation electrode layer (14) is formed divided nearly in the shape of a rectangle.

4. The antenna (20) according to claim 1, comprising a plurality of second radiation electrode layers (22, 23, 24, 25) in a nearly rectangular shape which are disposed in portions corresponding to the positions which surround all the four sides of the first radiation electrode layer (13) which is formed as nearly a square.

5. The antenna (20) according to claim 4, wherein a first pair (22, 23) of the plurality of second radiation electrode layers are coupled nearly in the shape of the letter L, and wherein a second pair (24, 25) of the plurality of second radiation electrode layers are coupled nearly in the shape of the letter L.

6. The antenna (1; 20) according to any of claims 1 to 5, comprising a connector serving as a coaxial line for feeding to the first radiation electrode layer (13), said connector being inserted into the through hole (15).

7. The antenna (1; 20) according to claim 1, wherein said first radiation electrode (12) is shaped nearly as a circle.

8. The antenna (1; 20) according to any of claims 1 to 7, wherein said first radiation electrode layer (13) comprises a degeneration separation section (13a).

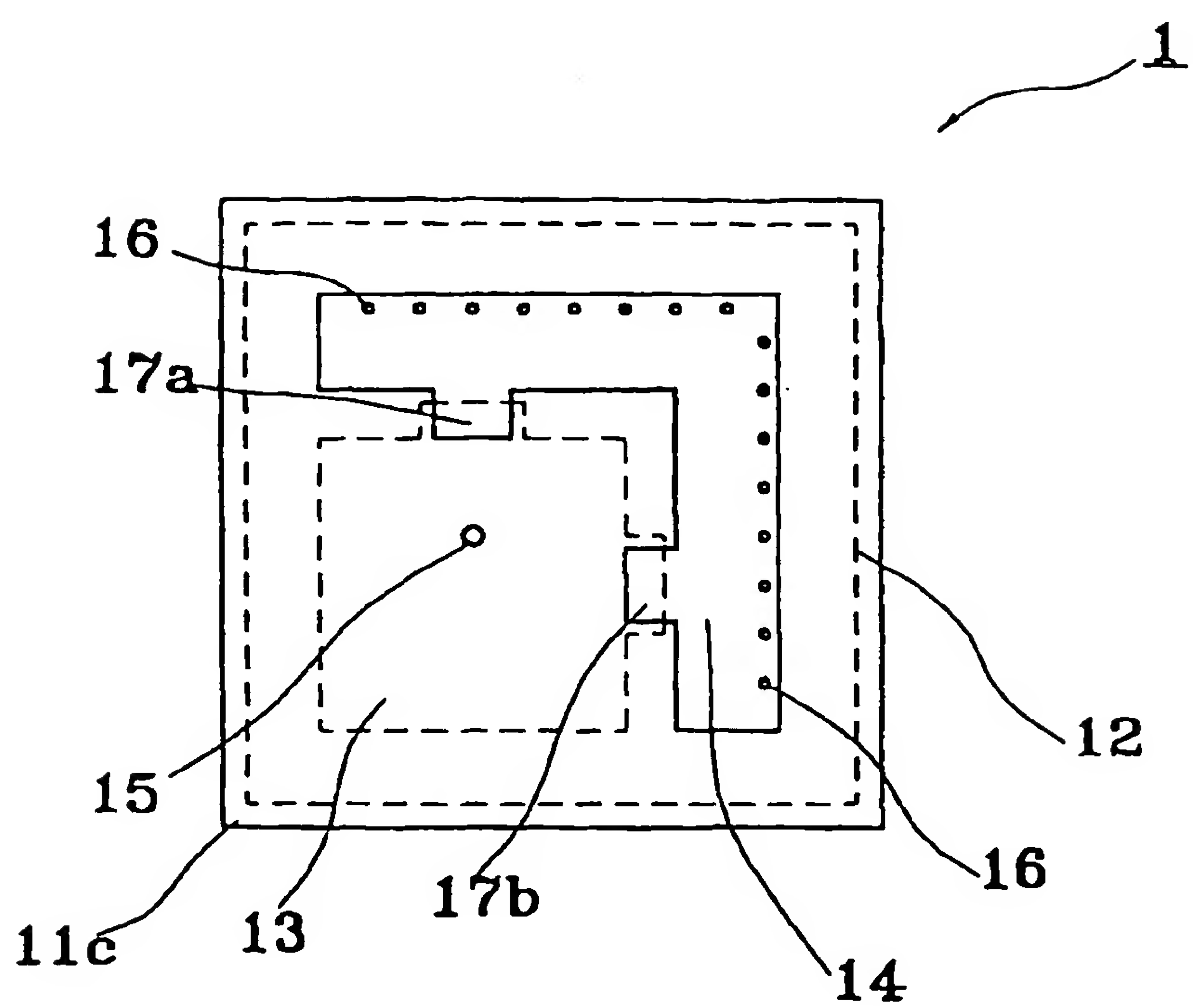

FIG. 1

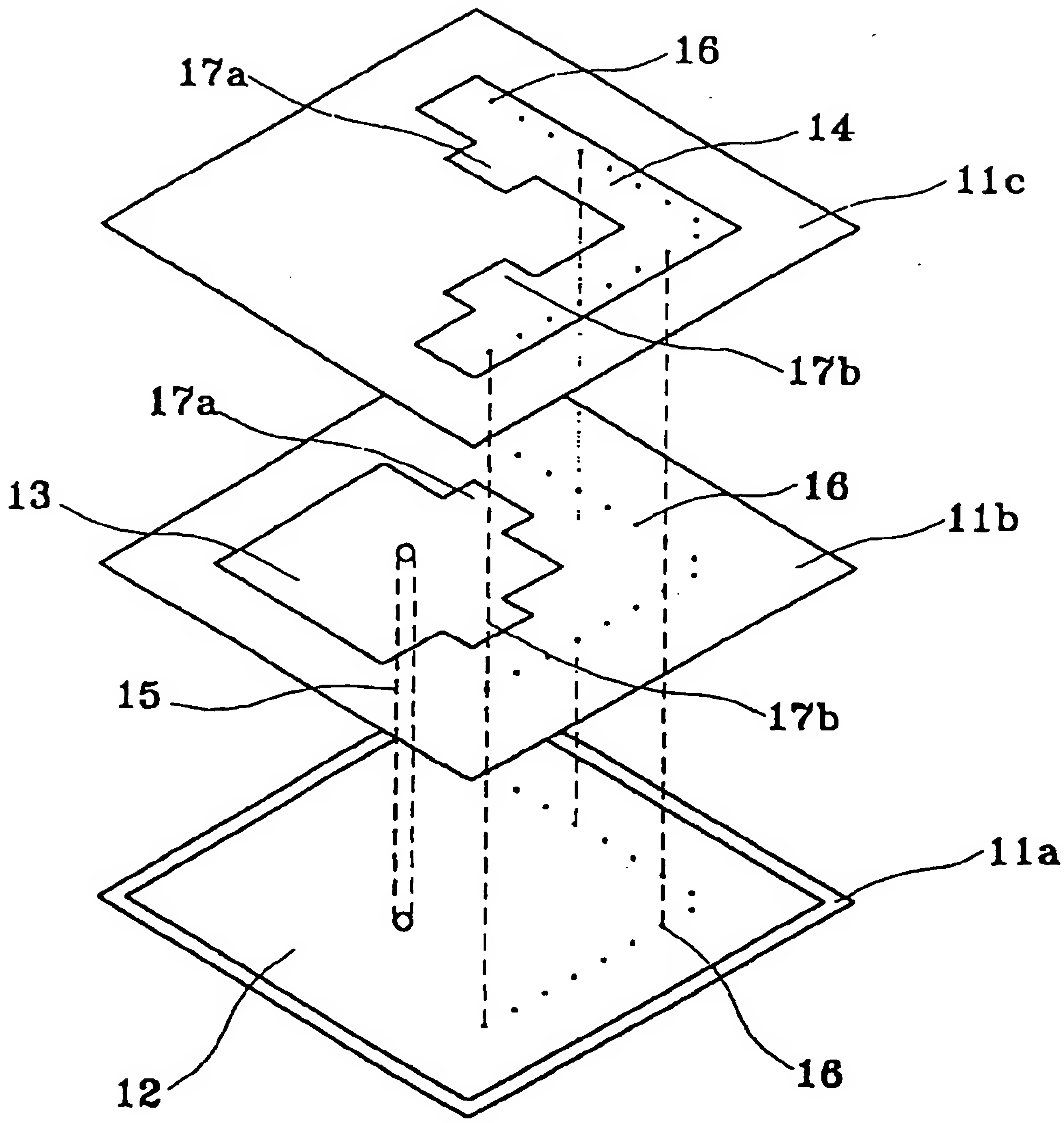

FIG. 2

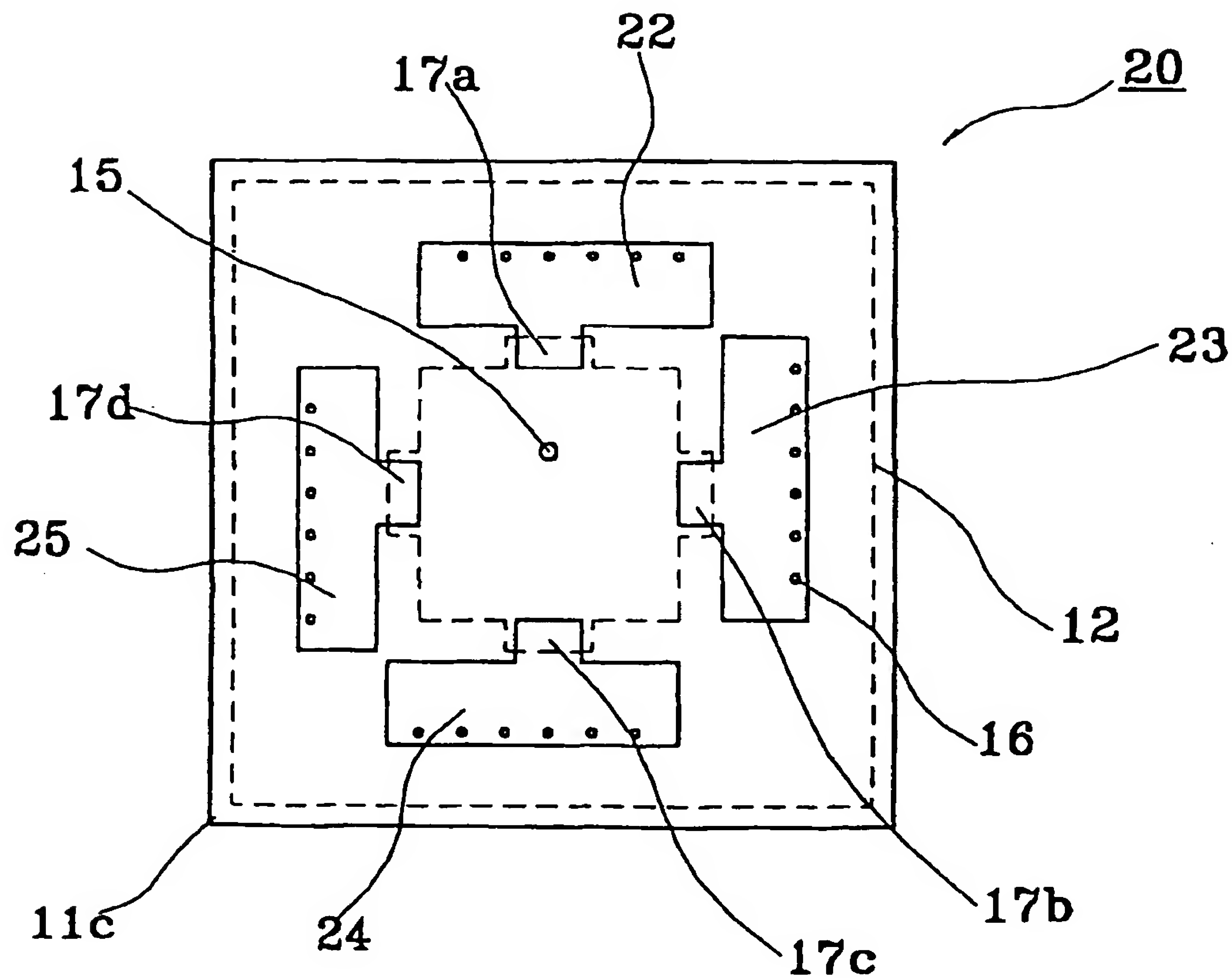

FIG. 3

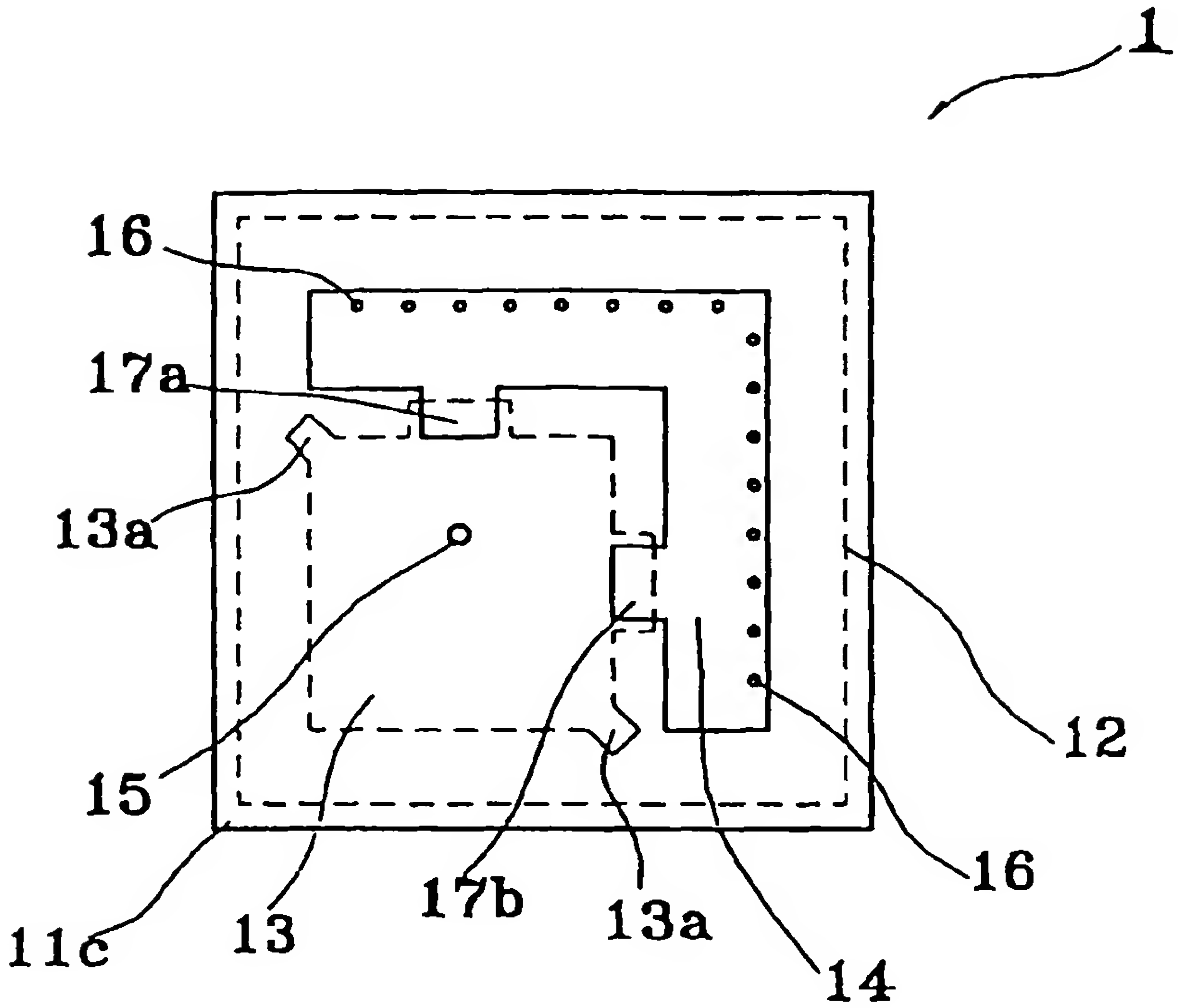
1
16
17a
13a
15
11c
13
17b
13a
14
16
12

FIG. 4

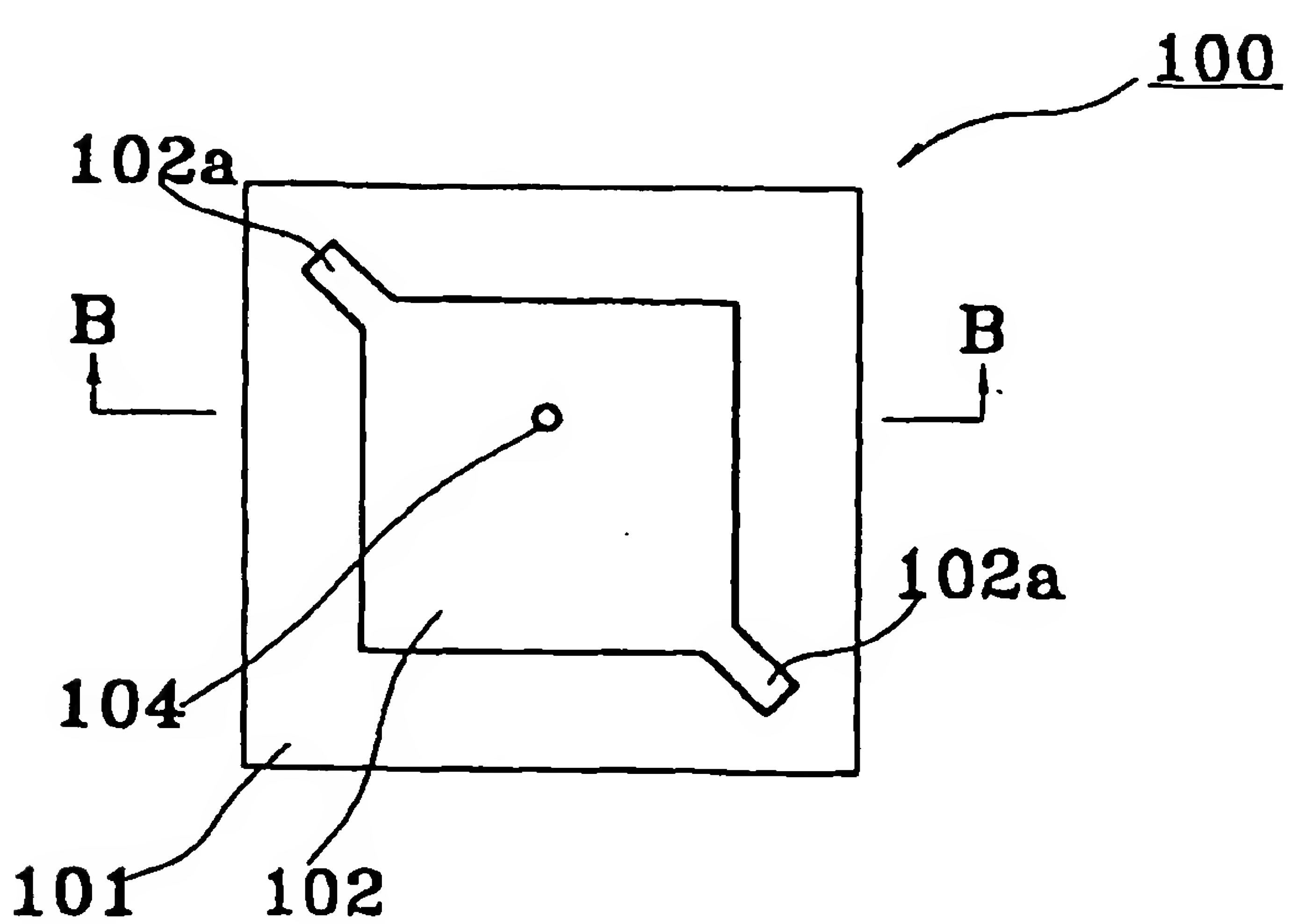
100
102a
B
B
102a
104
101
102

FIG. 5

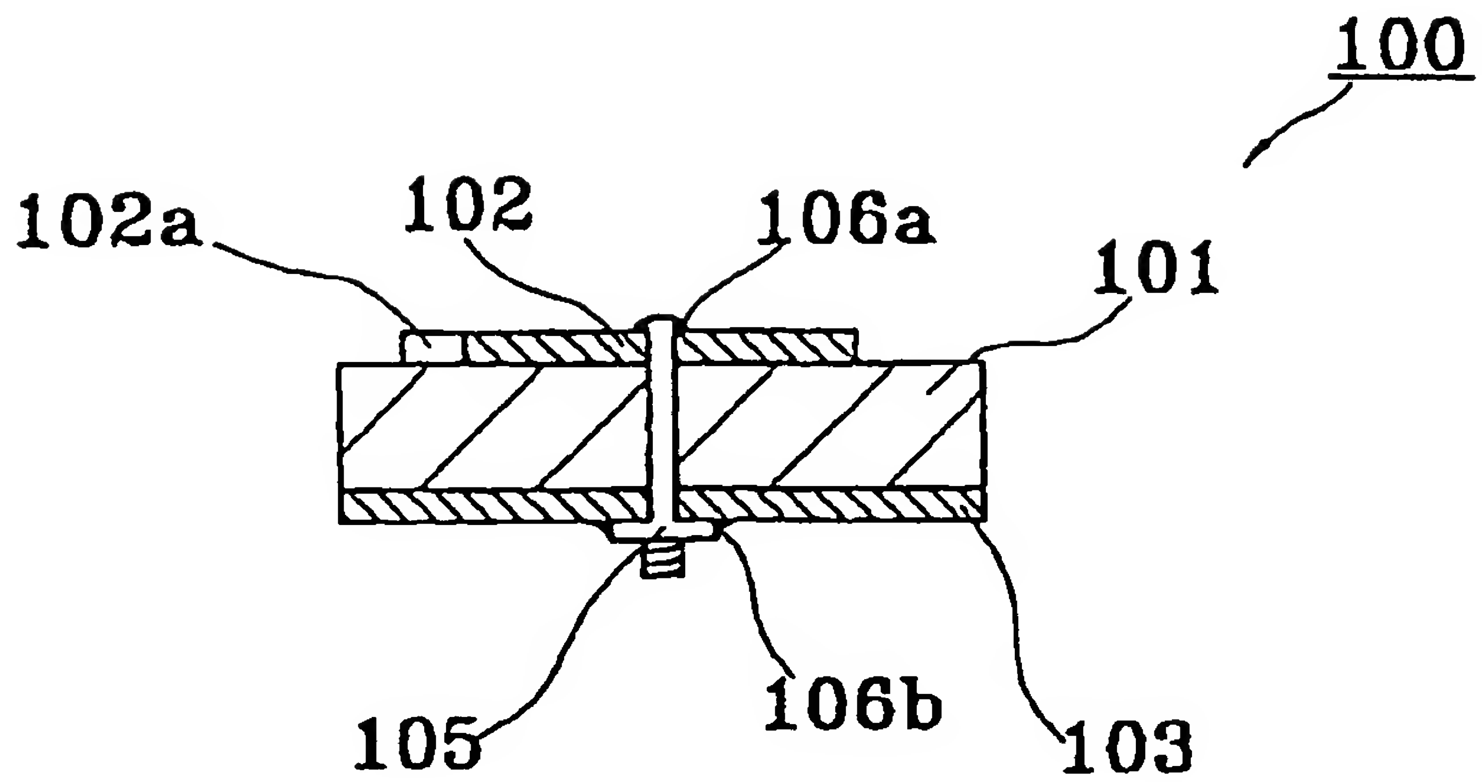

FIG. 6

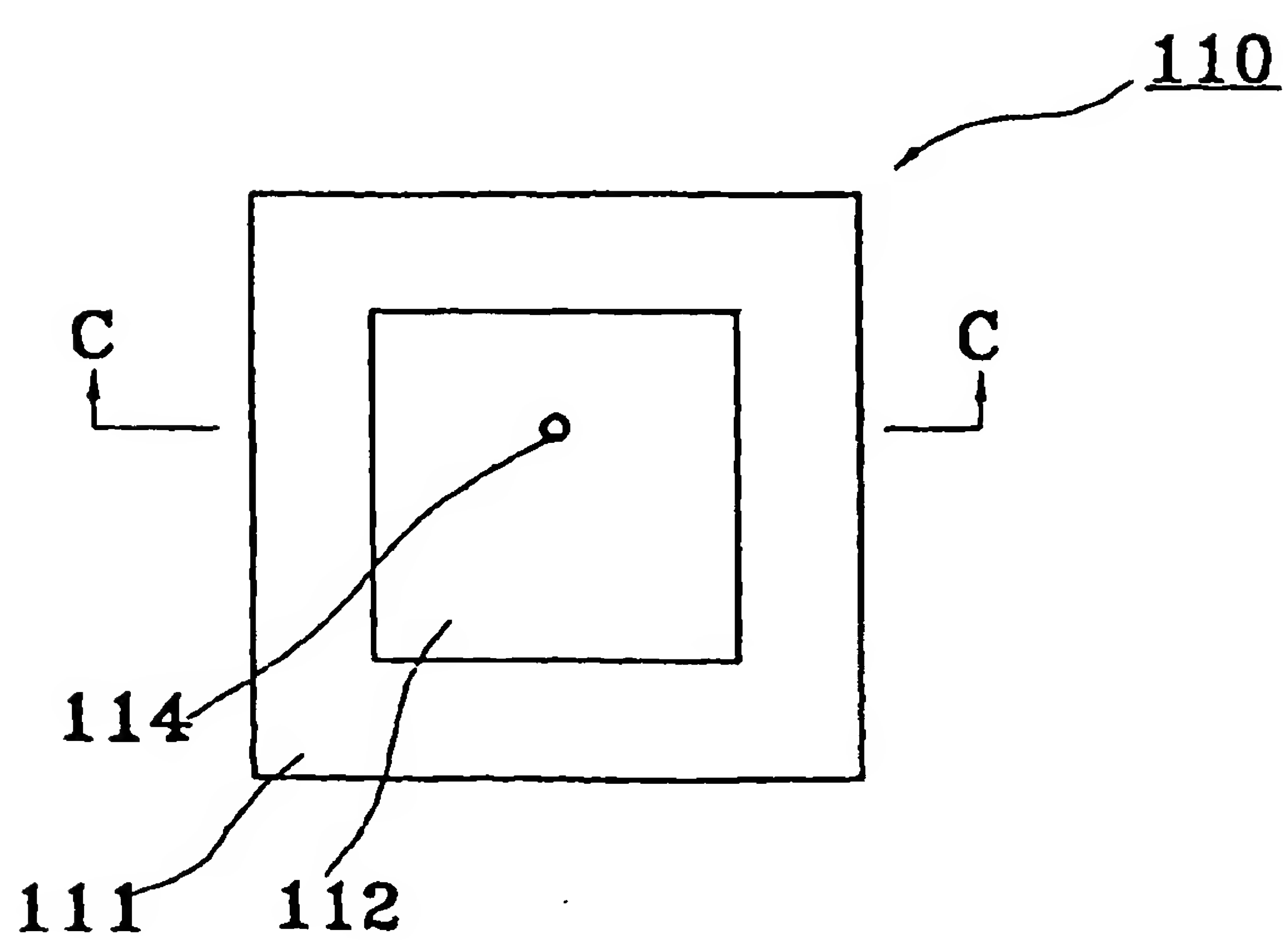

FIG. 7

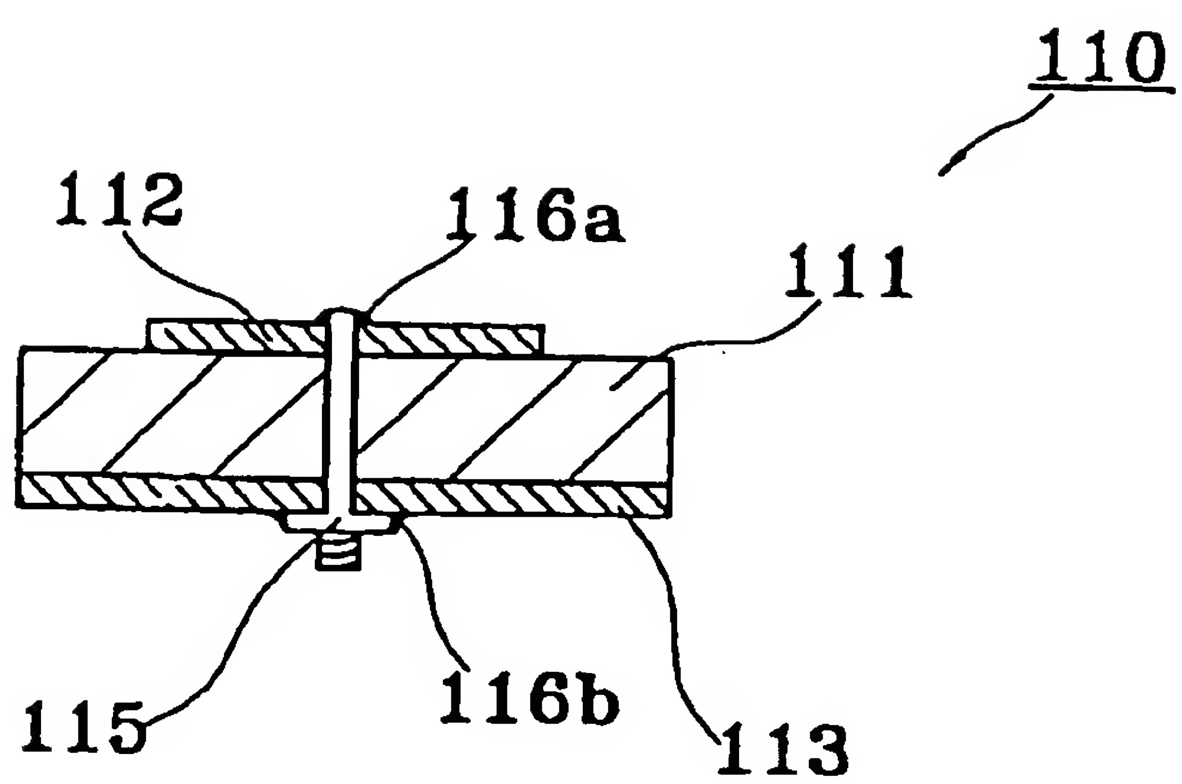

FIG. 8